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EVOLUTION OF THE DEFENSE MAPPING AGENCY'S DIGITAL DATA SPECIFIC--ETC(U)
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The Defense Mapping Agency was given the responsibility in 1975 to produce all digital data for the DoD. Since that time changes in user requirements and improved production techniques have resulted in a number of specification changes. This paper will discuss the evolution of the specifications to the present, the development of a Prototype Specification to support high resolution sensor simulation, and the follow-on proposed Digital Data Base 1985 which is expected to support multiple applications.

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EVOLUTION OF THE DEFENSE MAPPING AGENCY'S DIGITAL DATA SPECIFICATIONS

Ronald J. Pierce
Defense Mapping Agency Aerospace Center
St. Louis AFS, MO 63118

ABSTRACT

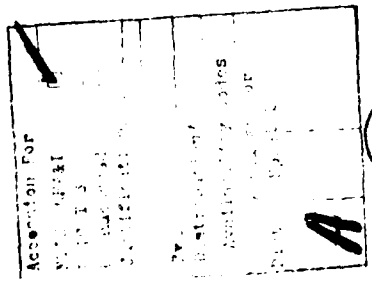
The Defense Mapping Agency was given the responsibility in 1975 to produce all MC&G digital data for the DoD. Since that time, changes in user requirements and improved production techniques have resulted in a number of specification changes. This paper will discuss the evolution of the specifications to the present, the development of a Prototype Specification to support high resolution sensor simulation, and the follow-on proposed Digital Data Base 1985 (DDB-85) which is expected to support multiple applications.

The computer hardware technology is growing faster than the software technology to make simulators able to portray realism. Both these technologies are growing much faster than DMA's ability to produce the digital data bases required to support the simulators. DMA's effort toward developing the DDB-85 will help narrow the gap of these technologies.

BACKGROUND

The Defense Mapping Agency first began producing digital data in the early 1960's. Terrain data was collected for use in an automated system of carving three dimensional relief maps. In 1966, the Universal Automatic Map Compilation Equipment system (UNAMACE) was put into production at DMA as the first piece of automated digital data collection equipment. The UNAMACE digitizes elevations directly from rectified stereoimagery and is used to output orthophotographs and terrain elevation matrices.

In 1972, DMA was asked to produce a digital data product to simulate radar displays in simulators for aircrew training. An R&D Project 1183 was established to determine the feasibility of creating that product and to develop digital data specification for radar simulation. The project came to a successful completion with what is now known as the 1974 DLMS Specifications. The DLMS product is composed of a matrix of terrain elevations called Digital Terrain Elevation Data (DTED) and cultural data called Digital Feature Analysis Data (DFAD). DFAD predicts the radar reflectivity of the earth's surface. The DLMS program supports Weapon Systems Trainers (WST) and operational uses such as cruise missile planning, Firefinder, aircraft mission planning, etc. The DLMS program requires millions of square nautical miles of DFAD and DTED.



As experience and user feedback were gained in using the 1974 DLMS specification, DMA refined the data base specification commensurate with current production capabilities to better support sensor simulation. The specifications were first revised in July 1977, with three smaller revisions (Changes 1, 2 and 3) in 1980-1981, resulting in the current product specification. Another major change is currently in coordination which will be called 2nd Edition DLMS. Some of the major changes contained in these revisons are:

a. Standardization of feature descriptors - e.g., Surface Material Code (SMC) 3 Isolated Farm structures portrayed as point feature.
b. Increase number of feature identification codes - e.g., from 57 to over 260.
c. Decrease minimum size for strong reflectors -e.g., Bridge.
d. Increase minimum size for poor reflectors - e.g., Desert areas.
e. Expansion of unique features - e.g., Railroad Gantries/Pylons.
f. Standardization of percent of roof cover descriptor -e.g., 0%, 10% and 30%.
g. Portrayal of permanent snow and ice
h. Addition of LOC's (lines of communication) 2nd edition DLMS

PROTOTYPE PRODUCT SPECIFICATION FOR HIGH RESOLUTION SENSOR SIMULATION

In 1978 DMA received an Air Force request to supply digital data to support an out of the cockpit visual simulator. Until this request was received, DMA had only been supporting radar simulation requirements and the specifications were designed for that purpose only. With the advent of visual requirements, it became obvious to DMA that a major revision to the digital data specification was required.

Investigations were begun to determine the data elements required for visual simulation. Discussions with various DoD users and contractors revealed that no one had the same requirement for MC&G support. Recognizing the importance of the next generation of specifications, DMA hosted a meeting at St. Louis in Sept 1978 for interested DoD users and contractors to take part in preparing a specification for visual simulation. Personnel in attendance represented Hq Strategic Air Command (SAC), Hq Military Airlift Command (MAC), Hq Tactical Air Command (TAC), Pacific Air Forces (PACAF), Naval Training and Equipment Center (NTEC), Aeronautical System Division (ASD), Engineering Topographic Laboratory (ETL), Rome Air Development Center (RADC) and both centers of DMA, Hydrographic/Topographic Center and Aerospace Center. The first meeting resulted in a decision to develop a Prototype Specification which was designed to support high resolution sensor simulation including Visual, Synthetic Aperature Radar (SAR), Low Light Level Television (LLLTV) and Infrared (IR). The prototype will be used to evaluate how well high resolution sensor simulation can be supported by an enhanced DLMS type data base.

This paper covers only the planimetric (cultural and landscape) features. DMA believes that Standard Level I DLMS Terrain will be satisfactory for high resolution sensor simulation.

DRAFT SPECIFICATION

The next generation specification is one that must satisfy requirements for all services, therefore, DMA developed a policy on Future Data Bases to include the following major points:

1. Common data elements will be established for multiple applications.
2. The data will be stored in such a way as to permit multiple product generation.
3. The format will be designed to support evolving requirements.
4. In order to save critical manpower, DMA will produce to the most stringent requirements where multiple products are scheduled.

Utilizing this guideline and meeting with the commands and their laboratories, a prototype product specification was prepared and published in December 1979. Five areas in the continental U.S. were selected to be compiled to this specification and production was initiated.

SPECIFICATIONS CHARACTERISTICS

The Prototype Specification consists of geographically defined areas (manuscripts) which describes the geographic location and the associated descriptive information defining natural and man-made features on the surface of the earth (similar to current DLMS). Level V, which is similar to Level I DLMS, is comprised of relatively large geographically defined areas containing a description and portrayal of natural and man-made features presented in a standardized digital format. Level V data is designed to cover large expansions of the earth's surface; therefore, it is designed to contain a generalized portrayal of features. Level V is meant to support high deta by using Computer Image Generation (CIG) and Synthetic Break-Up (SBU) techniques. CIG and SBU are processes by which descriptions of large homogeneous areal features (regions) are used with computer software to break features into component parts. It is expected that these techniques will be employed by the user as required.

MAJOR DIFFERENCES BETWEEN THE PROTOTYPE SPECIFICATION (LEVEL V) AND THE DLMS SPECIFICATIONS(LEVEL I)

1. Level V includes more features than Level 1.

Level V includes all Lines of Communication (LOC) such as roads, railroads/powerlines, etc., and streams, lakes and ponds. Level I was developed for radar simulation and generally contains only radar significant features.

2. Level V Utilizes microdescriptors

Microdescriptors (feature attribute attachment) are multipurpose descriptors which describe additional (visual) characteristics of a feature. By using this information as the basis for statistically based feature generation, a more realistic breakup can be performed than by purely random means. Four microdescriptors were developed for Level V.

3. Level V has additional Surface Material Code (SMC-14 asphalt)

This was included in SMC 9 in the DLMS specification.

4. Level V portrays isolated structures (SMC-4) including composition structures that are not radar significant but are visually significant.

5. Feature Area code (FAC) #1, of Level V is the most predominant background feature. In the DLMS specification, feature #1 is always normal soil.

6. No feature separation criteria is included in Level V. DLMS has an areal feature separation of 500 feet. Level V, without this separation, can be utilized to generate more realistic scenes by showing continuous steams/features regardless of width.

7. Level V portrays wood obstructions 50-150'. DLMS portrays only those obstructions over 150'.

TERRAIN ANALYSIS DATA

In the fall of 1981, DMA was asked to expand the Level V format to accept the data elements of terrain analysis using DMAHTC's Draft Production Specifications for the Tactical Terrain Data Base (1:50,000) dated September 1981. DMAAC created three additional microdescriptors and coordinated with HTC and Army personnel on common data elements. An area in Ft. Lewis, Washington was selected as a test. In order to compare the density of data and evaluate content, Level V and Level V enhanced with terrain analysis, were both compiled over Ft. Lewis.

Figure 1 is a portion of the manuscript of the Ft. Lewis area compiled to the current 1977 DLMS specifications. Figure 2 is the same area compiled to the Level V specifications and Figure 3 is the Terrain Analysis Specifications. The correlation of these three specifications is extremely close. Level V is compatible with Level 1 but defines the features in more detail. The terrain analysis manuscript is compatible to the Level V, and also portrays much more detail. Figure 4 shows Level V and terrain analysis data merged and plotted into a manuscript for both Air Force and Army programs. This is the new Prototype High Resolution Specification capable of multiuse. It has common data elements and can be expanded to accept new requirements.

DATA DENSITY

The density of the data, as well as resources required for Level V or enhanced Level V, can increase 3-5 times over the current Level 1. In order to handle this magnitude of data, and have a specification that is flexible to support multiple products, three additional microdescriptors are required. These microdescriptors plus the four developed for Level V can be used when necessary to further define a feature to satisfy a specific product requirement. The available microdescriptors are as follows:

1. Vertically composite feature (e.g., tower on a building).
2. Homogeneous area descriptor (e.g., residential area).
3. A pattern definition (e.g., street or field pattern).
4. Combination of 2 and 3.
5. Vegetation
6. Transportation — designed specifically for Terrain Analysis elements
7. Surface Drainage

Figure 5 is as an example of data stored on a microdescriptor. For purposes of this example, feature number 97 will be utilized (Table 1).

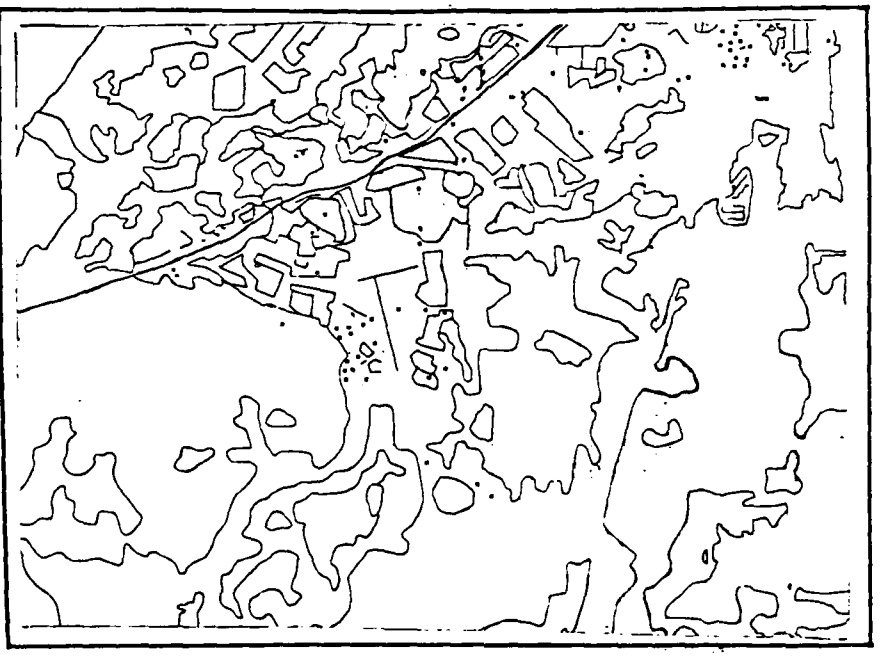


Figure 1 - Current DLMS Level I

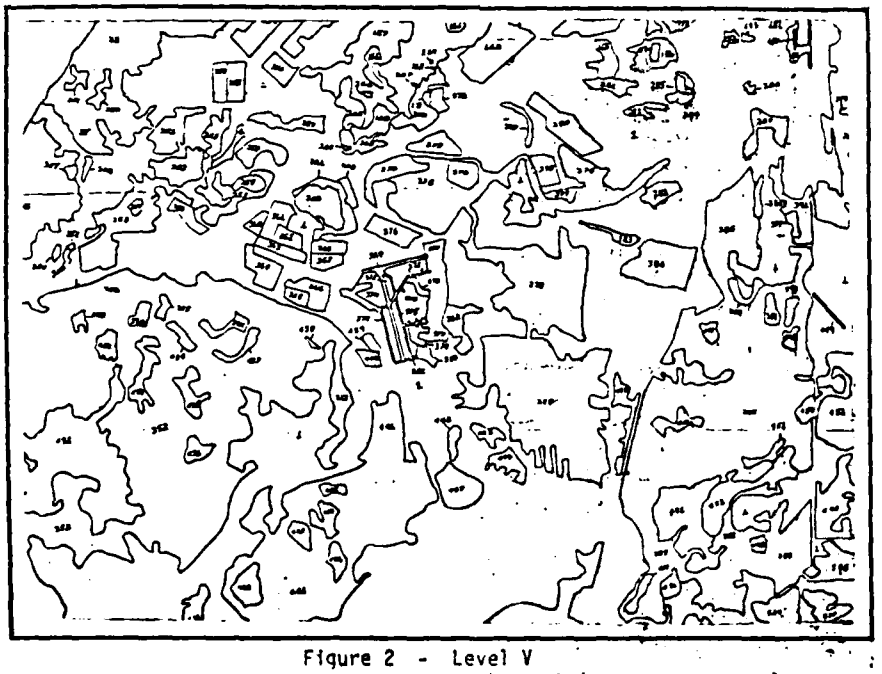


Figure 2 - Level V

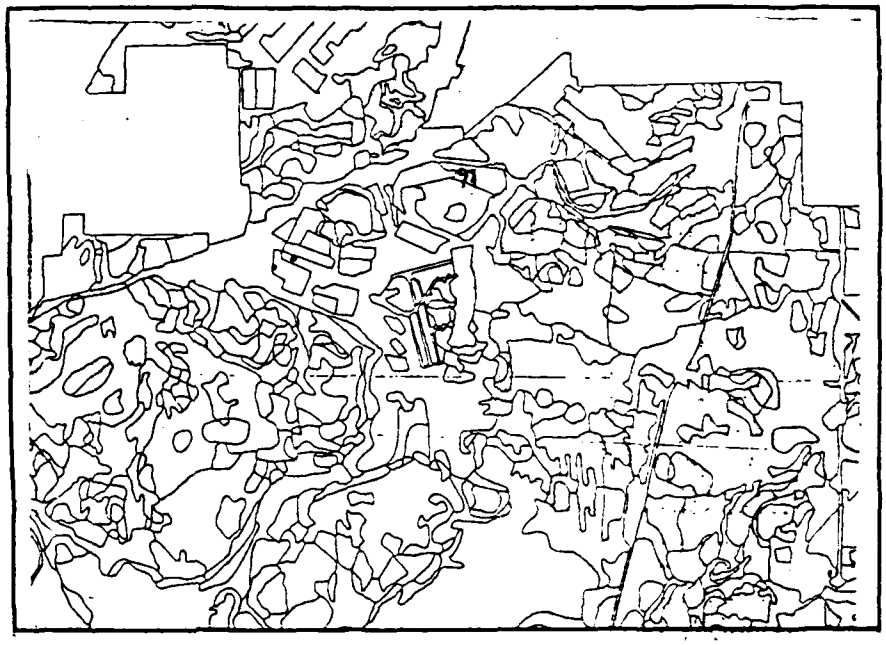


Figure 5 - Ft. Lewis, Washington Manuscript (Areal Features)

The Feature Analysis Data Table contains all the data recorded by the analysts for this feature. The top line is the primary descriptive information which is determined for all features (Table 2) and the succeeding lines will be microdescriptor information, if required. Feature number 97, is a forest area and requires the microdescriptor number 5 to satisfy the user requirement in this geographic area. (Table 3)

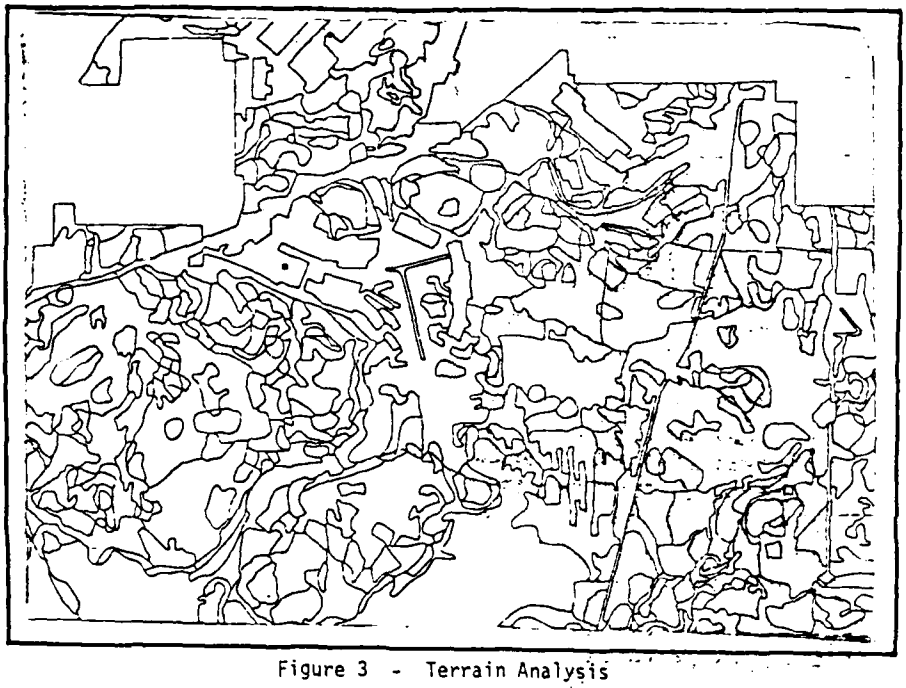


Figure 3 - Terrain Analysis

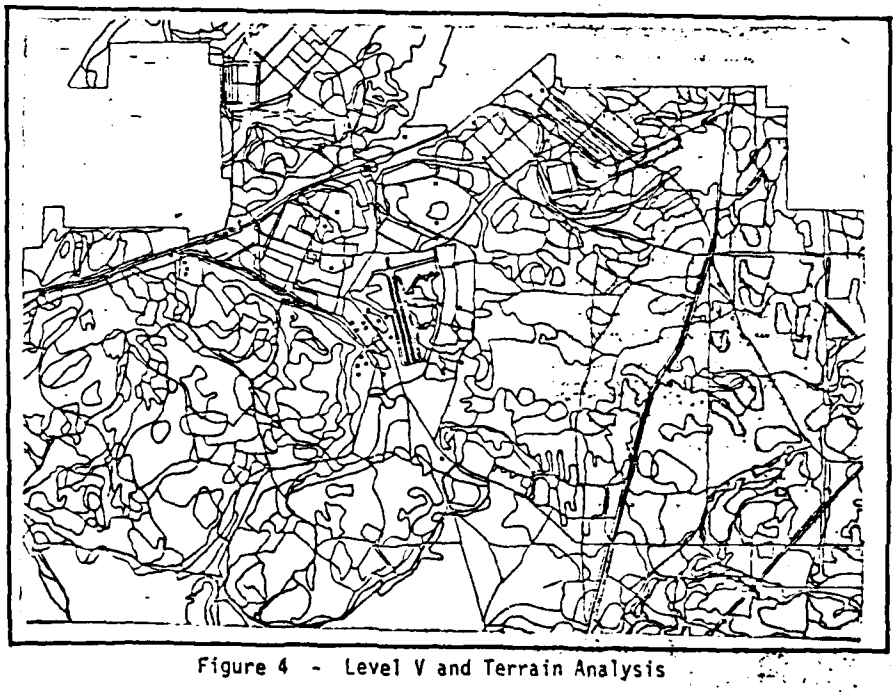


Figure 4 - Level V and Terrain Analysis

TABLE 1

FEATURE ANALYSIS DATA TABLE

```
96  2  4000   4  1     3        4  56  10                    2
96  1  10    32 10
96  5         1

97  2  953112                   18                          1
97  5  3  9 11    4  2  0  0              3  1 1  2  8
98  2  4000   4  1     3        4   56   10                   2
98  1  10    32 10
98  5         1
99  2  953112                   18                          1
99  2  3  9 11     4  2  0  0              3  1 1  2  8
```

CODED DESCRIPTIVE DATA FOR FT. LEWIS, WASHINGTON

TABLE 2

FEATURE ANALYSIS
DATA TABLE (FADTP)
PRIMARY DESCRIPTOR

- FAC NUMBER-97
- FEATURE TYPE-2
- FEATURE IDENTIFICATION CODE-9531
- SURFACE MATERIAL CATEGORY-12
- PREDOMINANT HEIGHT-18
- NUMBER OF MICRODESCRIPTORS-1

TABLE 3

VEGETATION
MICRODESCRIPTOR #5

FAC NUMBER-97
MICRO TYPE-5
CANOPY (SUMMER) CLOSURE-3
STEM DIAMETER-9
STEM SPACING-11
VEGETATION ROUGHNESS FACTOR-4

UNDERGROWTH-2
TREE CROWN DIA-0
HEIGHT OF LOWEST BRANCH-0

SPECIFIC TYPE-3
QUALIFIER-1
STATE OF GROUND-1
DEPTH OF SMC ROUGHNESS-2
(MED & HEAVY TANKS)-8
ROUGHNESS (LARGE WHEEL VECH)-0
ROUGHNESS (WHEEL VECH)-0
ROUGHNESS (FOOT TROOPS)-0
CLOSURE RATED CONE INDEX-0

PROTOTYPE TEST AREA

The five geographic areas selected by the users for testing the Level V specification are as follows:

Area 1 - A rectangle around Norfolk, VA and NAS Oceana containing approximately 450 SNM.

Area 2 - A 15 mile radius circle centered on the main runway at Barksdale AFB, LA (700 SNM).

Area 3 - An area around Little Rock AFB, AR containing 1850 SNM.

Area 4 - 100 SNM over New York City covering Manhattan, Island.

Area 5 - Fallon, Nevada. An area of approximately 1400 SNM.

These five areas will provide the user all types of culture and landscape information from large cities to desert areas and allow the user to evaluate the adequacy of the specification.

An additional area, No. 6, Ft. Lewis, Washington, has been produced containing both Level V and terrain analysis data. This area contains 250 SNM.

Other areas are being compiled to the terrain analysis enhanced Level V specification and should be completed by the end of 1982.

SUMMARY

Six domestic areas have been compiled using the new specification. These areas combined total approximately 5000 square nautical miles. The areas will be made available to the users for test and evaluation of the data content. DMA will be requesting comments on the specification as to the ability to satisfy current and future requirements. ASD is working with interested contractors and plans to solicit their comments. The Federal Republic of Germany and the United Kingdom have also indicated interest in the new specification. A copy of the specification and a magnetic tape of the Ft. Lewis area is being provided these NATO countries for their evaluation and comments.

An evaluation plan is presently being developed by a committee headed by HQ DMA with members from each service, DMAHTC and DMAAC. The purpose of this plan is to establish milestones to insure that all comments are considered in the revision of the final specification. The goal is to have a specification that will support an all purpose multiuse digital data base in 1985,--DDB-85.

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Defense Mapping Agency; 1977; "Product Specification for Digital Landmass (DLMS) Data Base" St. Louis AFS, MO.

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Faintich, M.B.;1981; "Increased Sensor Simulation Capability as a Result of Improvements to the Digital Landmass System (DLMS) Data Base." Proceedings of the Image Generation/Display Conference II, June 10-12, 1981, Scotsdale, Arizona, pages 181-196.

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